clear that under such conditions the wind estimate from either map A or B would be somewhat in error, assuming the gradient-wind conditions obtained. Nevertheless, when we consider that the difference between the sea-level map and those for the upper level is so striking, and that the differences between individuals A, B, and C are so small, there is little doubt that the important and significant features of the true isobaric distribution at the upper level are depicted. The anomalous loops, such as that about Royal Center, Ind., on map A, when based on a single station, are easily recognized as erroneous and allowance can be made. But this should not be necessary, and it is contended that if the type of map exemplified by map B were used—that is, if the aerological stations were not used but near-by regular stations substituted, so far as possible—the resulting maps would be highly accurate and dependable so far as free-air barometric gradients are concerned. This procedure is suggested in further activities of this character.

CONCLUSION.

An effort has been made in this paper to set forth clearly and impartially the results of a statistical examination of a three months' series of free-air pressure maps. It was first shown that a very large percentage of comparisons between observed and computed pressures lay within small error limits, better results being obtained at the 3,281-foot than at the 6,562-foot level. With all the uncertainties of the gradient-wind assumptions and the short-period vagaries of the observed wind, an extremely high percentage of agreement (practically the same at both levels) was found between the wind estimated from the isobaric charts of the free air, and that observed by pilot balloons. The average velocity of the wind falls off appreciably with the larger errors of estimated wind direction, so that, usually, when a serious error of estimation is made, the velocity of the wind is so small as to render the wind direction inconsequential. This is especially significant in estimating winds for aircraft. On the poorest day available the difference between maps drawn with and without the aerological stations and also with the observed pressures at aerological stations was so small that little-differing conclusions might be drawn from each.

It was stated in the beginning that if the maps could be proved to be accurate their scientific value would stand unchallenged. If this discussion of the accuracy of the maps has been convincing, it will be seen that there is here provided a means of knowing, quite independently of current aerological observation, the current wind conditions in the free air over large areas of the country, whether the weather be clear or cloudy. At present, the pilot-balloon stations telegraph the free-air winds as soon as possible for the use of the forecaster. Often such observations are impossible because of cloudiness, rain, snow, or fog. When used in conjunction with the aerological reports, these charts should constitute a most valuable means of weaving the various reports into a continuous pressure system, a speculative and uncertain matter at present. The advantage of such maps for aviation is obvious.

It would be quite impossible, even if it were within the scope of this paper to discuss the point, to indicate the precise manner in which these charts should be utilized in general forecasting. That must be determined by actual trial; and by actual trial is meant day-to-day telegraphing of free-air pressures in order that they may be available to the forecaster for comparison with other data while the current weather situation is fresh in mind. It is common knowledge that the growth of aviation implies increasing demands upon the Weather Bureau. Is it not essential, therefore, that every means be employed to acquire experience and familiarity with actual physical processes in the free air, while the science of aeronautical meteorology is yet in its infancy? The day will come when this knowledge *will* be required, and since it can only be acquired by experience it is the exercise of foresight to make a practical trial of the maps. This trial should continue for at least a year, and, during that time, all possible constructive criticism should be brought to bear upon the maps.

Acknowledgments.—The large amount of observational data used for comparison purposes in this paper could not have been assembled without the enthusiastic assistance of Mr. L. T. Samuels, Mr. W. C. Haines, and their associates in the Aerological Division of the Weather Bureau. They manifested considerable personal interest in the results and contributed many helpful suggestions; they were particularly prompt, also, in supplying data and in ferreting out the facts concerning suspected errors. For this cooperation the author records his earnest thanks.

COX ON THERMAL BELTS AND FRUIT GROWING IN NORTH CAROLINA.[1]

By ALFRED J. HENRY.

[Weather Bureau, Washington, D. C., May 7, 1923.]

NOTE.—According to custom an abstract and review of MONTHLY WEATHER REVIEW SUPPLEMENT No. 19 is presented below. These SUPPLEMENTS contain the results of the more comprehensive studies made by Weather Bureau officials or others. They appear at irregular intervals and are generally too voluminous to appear in the REVIEW proper.

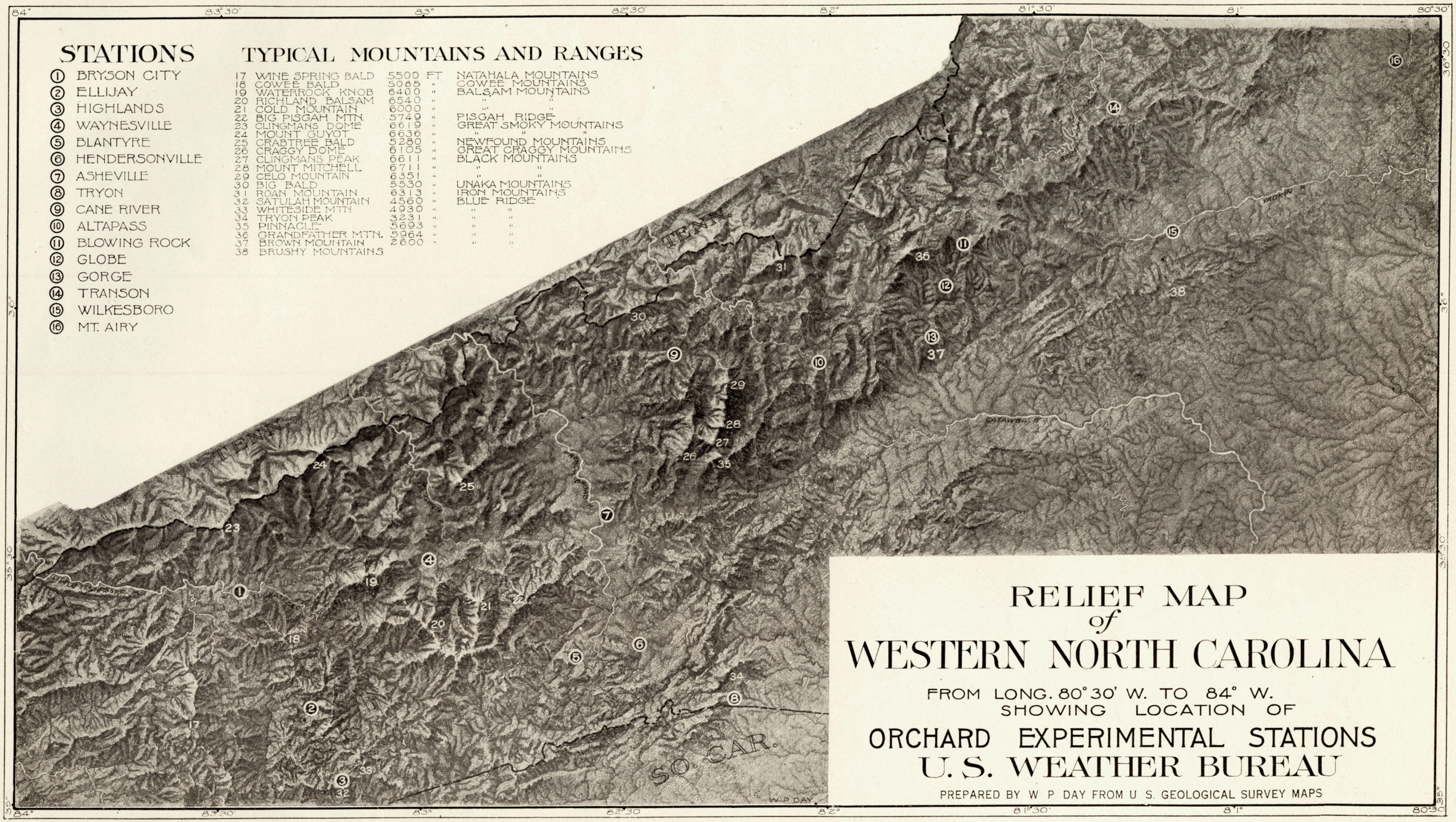
As a result of economies in printing that have recently become effective the edition of the SUPPLEMENTS is not large enough to supply the regular REVIEW readers. The SUPPLEMENT will be sent free, however, to those who may have a practical interest in the subject investigated, but only upon application, and so long as the bureaus' supply lasts. After that is exhausted applicants will be referred to the Superintendent of Documents, Washington, D. C. The price of this supplement is 50 cents.—EDITOR.

The phenomenon of the stratification of the air temperature over valleys and the inclosing slopes was brought to the attention of scientific men of the United States by Silas McDowell, of Franklin, Macon County, N. C., more than 60 years ago. McDowell was a farmer with leanings toward botany and geology, who spent his entire life in the mountain region of western North Carolina. His first published account of thermal belts or verdant zones, as he called them, appeared in the report of the Commissioner of Patents for 1861, and the substance of that report was later presented to the Philosophical Society of Washington (D. C.), by Dr. J. J. Chickering. The late Prof. John LeConte, of Berkeley, Calif., writing in *Science*,[2] confirmed McDowell's observations and added the statement that the ground in the thermal belts freezes in winter, a fact that might not be inferred from McDowell's description.

The explanation of the phenomena offered by McDowell would hardly be accepted at this time, but nevertheless

[1] Cox, H. J.: Thermal belts and fruit growing in North Carolina: with an appendix: Thermal belts from the horticultural viewpoint, by W. N. Hutt, former State horticulturist, MONTHLY WEATHER REVIEW SUPPLEMENT No. 19.

[2] 1883, vol. 1, p. 278.



50612—23. (To face p. 199.)

his observations, qualitative as they were, have since been fully confirmed. He also laid down the proposition that thermal belts must exist in all countries traversed by high mountains and deep valleys.

The evidence obtained by the use of kites and balloons clearly points to the fact that stratification of the atmosphere as regards temperature is not confined to mountainous regions, but also obtains over perfectly level surfaces on almost any winter night when the air is still. McDowell and other early observers used the mountains as a vantage ground to observe the phenomena, and in the absence of information to the contrary assumed that the mountains must be a causative agent in producing the stratification observed.

Fruit growers in North Carolina have been cultivating the apple and, in less degree, the peach for many years. These efforts have been attended in many cases by success and in other cases by failure. Immunity from frost damage on certain slopes has naturally directed attention to what, in the vernacular of the region, were known as "thermal belts," the term used by McDowell in 1858. Lacking definite quantitative measures of the differences between the temperature on the slopes that were immune from frost and those which were not, it is not strange that a former State horticulturist, Mr. W. N. Hutt, was led to remark:

> In making my trips over the State and in coming in contact with fruit growers, I kept up a constant quest for the elusive thermal belt, but, like an ignis fatuus, light and tenuous as the air, it always seemed to elude my grasp.

The above paragraph expresses the raison d'être for the investigation undertaken by the Weather Bureau at the request of the State authorities.

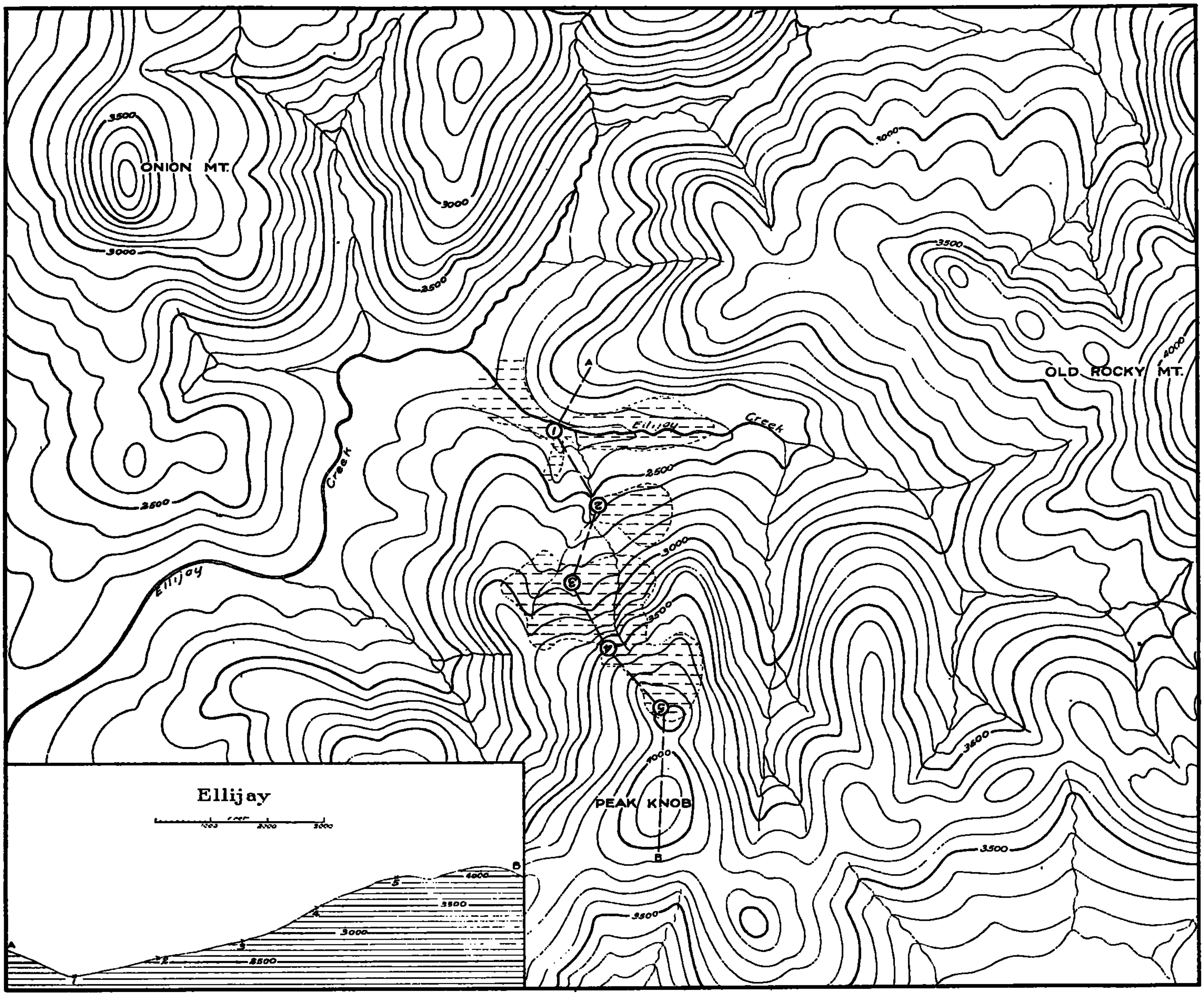


Fig. 2.—Ellijay, contour map and profile.

The results of this investigation are set forth in the publication under review. Observational work began in 1913 and was concluded in 1916, so that but four years are available for discussion. Unfortunately, the original compilations and the discussion were destroyed by fire while in transit between Washington and Chicago, and the entire work had to be done de novo.

The plan, in brief, contemplated the selection of a number of slopes of different aspect in the fruit growing districts of western North Carolina and to make systematic observations of temperature at different elevations upon the slopes. Eventually 16 slopes were selected and individual observing points ranging from 1 to 5 were installed on each slope. The geographic location of the several slopes is shown on Figure 1.

In all, between 50 and 60 stations were in operation during the life of the experiment.

It is exceedingly difficult to present within the limits of this review a full abstract of the results of the four years' work, but it appears least objectionable to present the data accumulated on one of the most important slopes as an index to the complete report.

The slope selected is that of Ellijay, one of the longest of the experiment. The topography of the immediate region in which the stations are situated is shown in Figure 2 and the following supplemental verbal description is supplied:

ELLIJAY.

Chas. G. Mincy, Observer.—The Ellijay stations, on a steep northerly slope of a spur of the Cowee Mountains, the base station, No. 1, being in the valley floor of Ellijay Creek at an elevation of 2,240 feet, while the high station, No. 5, is on the summit of a knob 1,760 feet above the base and 4,000 feet above sea level. Station No. 1, in a field about 30 feet south of the creek, over grass plot, at a considerable distance from any trees; across creek to the north, steep high slopes, more or less broken, while to the south, slope abrupt near the valley floor; orchard at some distance south of shelter on northerly slope broken and uneven with natural terraces here and there; valley narrow and trending in east-west direction, almost entirely inclosed by mountains. Station No. 2, in orchard, on rather steep northerly slope with ferns and weeds on all sides, 310 feet above station No. 1; timber to north, northwest, west and southwest; cleared land directly to east, northeast, and southeast, and for some distance to the south, about 500 feet. Station No. 3, the home station, 620 feet above station No. 1, over sod in apple orchard on moderate slope though steeper above and below, slope broken up into ridges and hogbacks. Station No. 4, 1,200 feet above station No. 1, in clearing and on edge of steep northerly slope in corn and potato patch; brush about 16 feet to the west; some timber 100 feet to the west and southwest. In winter sun shut off during greater part of day. Station No. 5, 1,760 feet above station No. 1, a level field near the summit of a high knob, another prominence, Peak Knob, 180 feet higher than station No. 5, distant 1,800 feet to the south timber to the west, southwest and south, mostly dead, close by; abrupt slopes to the north and east. Ellijay Creek, near which station No. 1, stands, flows in a westerly direction through a narrow valley, and the slope on the north side is broken up into spurs and hogbacks. For a vertical distance of 1,760 feet between stations Nos. 1 and 5 at Ellijay, there is a horizontal distance of about 5,100 feet, equivalent to an average grade of 19°. The grade on some portions of the slope is more than 30°.

The most important observational material is undoubtedly that of the minimum temperature registered during each night of the observational period. The monthly means as summarized by the author are presented in Table 1.

TABLE 1.—*Monthly and annual average minimum temperatures, 1913–1916.*

[The differences between the averages at the base station and those of the respective slope stations may be seen by simple inspection.]

Principal and slope stations; elevation of base station above mean sea level.	Height of slope station above base (feet).	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Altapass:														
No. 1, base station, elevation 2,230	....	[1] 31.1	[1] 29.1	[1] 31.5	[1] 44.2	52.8	58.4	62.5	61.3	54.0	46.3	36.6	29.8	[1] 44.8
No. 2, SE	250	[1] 31.5	[1] 29.6	[1] 31.3	[1] 45.3	54.0	59.2	63.1	62.1	55.5	48.2	38.4	30.2	[1] 45.7
No. 3 SE	500	[1] 31.4	[1] 29.3	[1] 30.8	[1] 44.5	53.6	58.6	62.7	62.0	55.3	48.0	37.9	29.7	[1] 45.3
No. 4, SE	750	[1] 29.4	[1] 27.3	[1] 28.9	[1] 42.3	51.8	56.7	60.5	60.1	53.3	46.6	36.2	27.8	[1] 43.4
No. 5, summit	1,000	[1] 29.1	[1] 27.0	[1] 28.8	[1] 42.1	51.0	55.8	60.2	59.5	52.5	45.2	35.4	27.4	[1] 42.9
Asheville:														
No. 1, base station, elevation 2,445	....	32.3	28.8	32.9	41.8	50.7	56.6	60.3	59.8	52.6	44.6	34.4	28.8	43.6
No. 2, N	155	33.3	29.7	33.6	43.6	52.9	58.0	61.4	60.4	54.6	45.9	36.5	29.5	45.0
No. 2a, S	155	34.5	30.6	34.7	45.0	53.9	59.1	62.4	61.7	55.7	47.5	37.6	30.9	46.1
No. 3, N	380	33.9	30.1	34.1	44.7	54.9	60.0	63.2	62.3	55.6	47.9	38.8	30.8	46.4
No. 3a, S	380	34.5	30.4	34.4	45.4	55.2	60.1	63.4	62.6	56.3	48.4	38.8	30.8	46.7
Blantyre:														
No. 1, base station, elevation 2,090	....	30.1	26.6	30.2	38.4	47.7	56.1	60.7	60.6	52.8	43.2	29.7	26.0	41.8
No. 2, NW	300	31.4	27.8	32.2	41.6	49.6	56.0	59.8	59.6	51.7	43.0	31.8	27.3	42.6
No. 3, NW	450	32.5	29.2	32.8	43.7	52.1	57.2	61.2	60.6	53.4	45.3	35.5	29.1	44.4
No. 4, NW	600	33.5	30.6	33.8	45.0	54.0	58.4	62.5	61.8	55.3	47.0	37.5	30.3	45.8
Blowing Rock:														
No. 1, base station, elevation 3,130	....	30.0	26.6	30.2	41.2	50.2	56.9	60.6	60.4	53.6	45.4	35.0	27.2	43.1
No. 2, SW	450	30.0	26.4	29.9	42.4	51.9	57.2	60.9	60.4	53.8	45.8	36.8	27.6	43.6
No. 3, SE	450	27.2	23.4	27.6	37.1	46.1	53.3	56.8	56.3	48.4	42.2	29.6	24.0	39.3
No. 4, SE	625	29.0	25.3	29.0	40.5	50.2	55.9	59.9	59.0	52.4	44.6	35.0	26.2	42.2
No. 5, SE	800	28.0	24.6	28.0	39.6	49.8	55.6	59.2	58.5	51.6	43.8	33.8	25.2	41.4
Bryson:														
No. 1, base station, elevation 1,800	....	[2] 31.3	[1] 27.4	[1] 28.3	39.4	48.5	55.7	60.0	59.8	52.6	43.1	[1] 30.7	[1] 26.5	[1] 41.9
No. 2, N	385	[2] 32.6	[1] 28.6	[1] 29.5	41.3	49.7	56.0	59.8	59.6	53.0	44.2	[1] 33.6	[1] 27.9	[1] 43.0
No. 2a, S	385	[2] 33.1	[1] 29.0	[1] 29.8	42.4	50.6	56.8	61.2	60.6	53.3	44.1	[1] 33.7	[1] 28.2	[1] 43.6
No. 3, summit	570	[2] 33.8	[1] 29.9	[1] 30.8	44.4	52.3	57.6	61.2	60.8	53.6	46.0	[1] 36.2	[1] 29.0	[1] 44.6
Cane River:														
No. 1, base station, elevation 2,650	....	[1] 26.4	[1] 25.7	[1] 27.2	37.6	46.6	53.9	58.1	58.0	49.6	40.4	28.5	24.8	39.7
No. 2 N	190	[1] 29.9	[1] 27.2	[1] 28.9	40.9	49.6	55.4	59.1	58.7	51.3	43.0	33.7	27.6	42.1
No. 3, NE	400	[1] 29.5	[1] 26.1	[1] 27.9	41.3	51.0	56.2	59.8	59.4	52.5	44.4	35.2	27.3	[1] 42.6
No. 4, summit	1,100	[1] 28.8	[1] 26.9	[1] 27.1	41.0	51.3	56.7	60.2	59.6	53.1	45.3	36.3	27.2	[1] 42.8
Ellijay:														
No. 1, base station, elevation 2,240	....	[1] 30.2	[1] 27.7	[1] 28.6	39.7	48.2	54.7	58.8	58.4	51.1	42.5	31.1	27.4	[2] 41.6
No. 2 N	310	[1] 31.1	[1] 30.0	[1] 30.5	42.6	51.0	56.6	59.9	59.0	52.0	43.7	33.8	28.6	[2] 43.7
No. 3, N	620	[1] 31.9	[1] 29.9	[1] 30.5	43.2	52.2	57.1	60.4	59.6	53.3	45.3	36.7	29.7	[2] 44.4
No. 4, N	1,240	[1] 32.8	[1] 30.8	[1] 30.8	45.4	54.8	59.4	62.1	61.2	55.3	47.7	39.1	31.1	[2] 45.8
No. 5, summit	1,760	[2] 32.6	[2] 29.6	[1] 28.6	[1] 44.2	[1] 54.0	[1] 58.4	[1] 60.9	[1] 60.0	[1] 54.7	[1] 48.1	[1] 37.7	[1] 28.6	[1] 44.9
Globe:														
No. 1, base station, elevation 1,625	....	31.8	29.0	32.4	41.9	51.1	58.0	63.0	61.6	54.6	46.5	34.6	29.2	44.4
No. 2, E	300	33.4	30.6	34.3	45.1	55.0	60.5	64.1	63.5	57.0	49.3	38.6	31.2	46.9
No. 3, summit	1,000	33.6	30.4	33.8	46.0	55.9	61.2	64.6	63.5	57.2	49.7	39.8	30.8	47.2
Gorge:														
No. 1, base station, elevation 1,400	....	30.8	28.1	32.3	40.5	49.3	56.8	61.1	61.0	53.9	45.2	32.8	27.9	43.3
No. 2, NE	290	30.6	27.8	32.0	41.2	50.2	57.2	61.0	60.8	53.6	45.1	33.8	28.6	43.5
No. 3, S	615	32.4	29.6	33.6	43.8	52.3	58.0	61.8	61.0	54.2	45.8	36.6	29.7	44.9
No. 4, N. (old); NE. (new)	840	33.0	30.2	34.4	45.6	54.8	59.7	63.2	62.4	55.9	48.0	39.1	30.6	46.4
No. 5, summit	1,040	33.5	30.9	34.4	46.9	57.0	61.4	61.9	63.7	57.7	49.9	41.1	32.0	47.8

[1] Three-year average.

[2] Two-year average.

Table 1.—*Monthly and annual average minimum temperatures, 1913–1916*—Continued.

Principal and slope stations; elevation of base station above mean sea level.	Height of slope station above base (feet).	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Hendersonville:														
No. 1, base station, elevation 2,200	....	[1] 28.9	[1] 27.3	[1] 28.3	38.8	47.8	55.4	59.6	59.8	51.8	43.2	31.1	27.4	42.0
No. 2, E	450	[1] 30.7	[1] 28.5	[1] 30.3	41.7	50.8	57.7	61.1	60.5	53.0	44.9	34.4	28.9	44.7
No. 3, E	600	[1] 31.5	[1] 29.8	[1] 30.7	44.0	53.2	58.7	61.8	61.4	54.7	46.9	37.4	29.7	46.2
No. 4, summit	750	[1] 31.7	[1] 30.0	[1] 30.9	44.6	54.2	59.3	62.6	61.6	55.5	47.8	38.4	30.1	46.8
Highlands:														
No. 1, base station, elevation 3,350	....	[1] 32.2	[1] 28.9	[1] 30.4	44.2	53.2	58.3	61.6	61.0	55.2	47.0	38.0	30.7	45.1
No. 2, SE	200	[1] 33.0	[1] 31.1	[1] 30.2	44.2	53.4	58.5	61.7	61.4	55.3	47.4	38.9	31.8	45.6
No. 3, SE	325	[1] 26.8	[1] 23.4	[1] 24.4	34.6	43.4	49.4	53.5	53.0	45.7	38.0	27.7	23.4	37.0
No. 4, SE	525	[1] 29.0	[1] 25.9	[1] 26.0	41.2	50.7	55.6	58.5	57.6	51.3	44.2	35.8	27.2	41.8
No. 5, SE	725	[1] 28.6	[1] 25.7	[1] 25.4	41.5	51.4	56.5	59.8	58.7	52.6	46.0	36.8	28.6	42.5
Mount Airy:														
No. 1, base station, elevation 1,340	....	33.0	30.0	34.6	45.0	53.6	60.5	64.0	63.4	56.3	48.2	37.0	30.2	46.3
No. 2, W	160	34.3	31.4	35.6	47.2	57.2	63.1	66.3	64.7	58.8	51.3	41.0	32.2	48.6
No. 3, E	160	34.0	30.8	35.3	46.4	55.6	61.8	64.7	64.0	57.6	49.7	39.0	31.8	47.6
No. 4, summit	360	33.9	30.8	34.7	46.8	56.8	62.6	66.0	64.9	58.8	51.2	40.6	31.8	48.2
Transon:														
No. 1, base station, elevation 2,970	....	28.8	24.7	28.4	38.3	46.4	53.3	57.6	56.6	48.8	41.4	30.4	24.5	40.0
No. 2, W	150	30.6	26.4	29.8	41.4	51.2	56.7	59.8	59.2	52.0	43.8	34.9	26.8	42.8
No. 3, W	300	30.4	26.8	29.8	41.8	51.2	57.2	60.6	59.8	52.8	45.1	35.9	27.0	43.2
No. 4, summit	450	[1] 29.1	[1] 27.2	[1] 27.8	42.0	52.3	57.5	60.8	60.0	54.2	46.3	36.9	27.3	43.8
Tryon:														
No. 1, base station, elevation 950	....	34.7	32.3	35.9	44.7	54.8	63.0	66.7	66.3	58.5	50.6	37.3	32.8	48.1
No. 2, SE	380	38.1	36.0	39.4	50.8	60.4	65.7	69.0	67.6	61.4	53.8	44.3	35.9	51.8
No. 3, SE	570	37.6	34.8	38.1	49.7	58.8	64.2	67.5	66.4	59.9	52.2	43.0	34.4	50.5
No. 4, SE	1,100	35.8	33.3	36.2	47.5	56.9	61.9	65.0	64.4	58.0	47.7	40.6	32.8	48.8
Wilkesboro:														
No. 1, base station, elevation 1,240	....	31.6	28.8	33.8	43.4	52.1	59.2	63.3	62.8	55.6	46.4	35.0	29.0	45.0
No. 2, N	150	33.1	30.4	35.2	45.7	54.9	60.6	64.4	63.7	56.2	48.4	37.6	30.7	46.7
No. 3, N	350	34.2	31.8	36.2	47.5	57.0	62.3	66.2	65.0	58.2	50.6	40.6	32.2	48.5
No. 4, W	430	34.2	31.4	35.8	47.4	57.3	62.6	66.5	65.6	58.3	50.6	41.2	32.3	48.6

[1] Three-year average.

It is to be noticed that, almost without exception, both monthly and annual means of the Ellijay slope stations are higher than those of the base due to what are generally known as "inversions" of temperature. Doubtless readers of the Review are fully cognizant of the significance of this term, but in the interest of those who may be less familiar with the subject, the following is offered:

Many observations on mountains and in balloons have shown that on the average, the temperature of the free air, when dry, diminishes about 1° F. for every 300 feet of increase in elevation. There are, however, many exceptions to this rule, as when the air instead of growing colder with increasing elevation actually becomes warmer up to a certain level, and then grows colder. This phenomenon is known as an "inversion" and the rate of warming with increase in altitude or cooling, as the case may be, gives what is known as the vertical temperature gradient. English meteorologists have recently come to use the term "lapse-rate" or "lapse" line to indicate the change of temperature with height.

The explanation of temperature inversions is found in an analysis of the relations which exist between the temperature, the pressure, and the volume of the atmosphere considered as a gas. Since the atmosphere is unconfined and subject to the perturbations introduced by the changing solar heat, diversified terrain, the presence or absence of large bodies of water and other causes, it is difficult to present a clear picture of the conditions which produce the warming and cooling of the air within a valley or upon a plateau. In general, it may be said that the atmosphere gets colder with elevation owing to its transparency to solar radiation; it is heated mainly at the bottom, or at the surface of the earth and because at ordinary temperature it emits more radiation than it absorbs.

For practical purposes one is not so much concerned with an explanation of the phenomenon as with the fact of its occurrence more frequently at one time and place than at another.

Returning now to a consideration of the mean minimum temperatures on the Ellijay slope, as well as those of other slopes in the investigated region, as found in Table 1, it is apparent that there is a pronounced seasonal influence on the several slopes, particularly on those characterized by temperature inversions. On all of these the months of April, May, October, and November show the greatest average difference between base and summit. Blantyre, Blowing Rock, Bryson, Cane River, Ellijay, Globe, Gorge, Hendersonville, and Transon are examples of marked differences between base and summit, the latter being the warmer.

A second point of interest in the figures of Table 1 is the fact that on the slopes of Altapass, Blowing Rock, Highlands, and in less degree Tryon, the minimum temperature at the base station, on the average, is *higher* than that on the summit or the reverse of the conditions that prevail at the other slopes. The explanations for these abnormal showings are given in full by Professor Cox; I can refer to only the most important in this review. At Altapass the base station lacks some of the characteristics of a true base station; at Blowing Rock the topography is the controlling factor; at Highlands the stations are located in two orchards, the Satulah and the Waldheim, the former, in which the base station is situated, is on a south slope and warm for its altitude.

In order to ascertain the frequency with which inversions occur on the Ellijay slope, I have tabulated, and present in Table 2 below, the individual differences between the base and slope stations for four different months, first, May, 1914, a month of frequent and, in some cases, large inversions; (2) November, 1914, a month of the same character, but in a different season; (3) January, 1916, a winter month, and (4) July, 1915, as representing a summer month. The figures in the columns headed "base" are the minimum temperatures at the base station, the figures in remaining columns are the differences between the readings at the base and at the slope stations above, absence of sign indicates higher temperatures and the minus sign, lower.

TABLE 2.—*Temperature differences between base and slope stations on Ellijay Slope for the months and days as shown.*

[Figures without sign indicate the amount the slope station is above the base; minus signs, below.]

Date.	May, 1914, many large inversions.					November, 1914, many large inversions.					January, 1916, typical winter inversions.					July, 1915, typical summer inversions.				
	Base.	No. 2.	No. 3.	No. 4.	No. 5.	Base.	No. 2.	No. 3.	No. 4.	No. 5.	Base.	No. 2.	No. 3.	No. 4.	No. 5.	Base.	No. 2.	No. 3.	No. 4.	No. 5.
1	40	1	3	6	7	26	6	9	17	18	44	0	−3	−1	−3	56	2	2	3	1
2	37	2	7	9	8	29	6	13	18	16	54	3	1	3	−1	56	1	−1	0	−1
3	41	4	8	9	9	33	5	10	15	16	31	4	5	7	6	55	3	3	5	3
4	54	1	2	1	0	35	7	12	18	15	20	6	9	6	9	59	2	1	1	0
5	59	−1	−2	−5	−6	33	7	15	17	13	28	5	6	10	8	61	2	−1	−2	−3
6	48	5	9	8	5	27	6	12	18	18	48	−1	−1	0	−4	47	4	4	5	5
7	45	2	5	8	8	30	8	13	20	23	49	−1	0	−2	−5	51	5	5	7	5
8	47	0	0	6	6	40	7	10	9	9	35	1	−3	−2	−3	61	4	4	4	2
9	45	−3	−4	−6	−7	35	0	0	0	−1	29	−2	−5	−4	−2	54	5	4	7	7
10	35	2	6	9	11	22	0	3	6	5	28	2	1	2	0	59	3	1	2	1
11	44	5	10	15	13	25	5	10	13	14	48	1	0	1	−3	58	3	2	2	1
12	49	6	9	13	10	25	5	8	17	18	53	2	1	0	−4	61	5	6	6	3
13	54	0	3	5	3	34	4	6	9	9	45	−2	−5	−6	−8	61	4	3	4	2
14	45	3	3	2	5	37	2	9	11	11	23	0	−3	−5	−2	56	4	4	6	6
15	39	1	4	5	2	51	−2	0	−1	0	25	1	1	−2	−3	60	2	1	3	3
16	39	3	7	9	6	42	−2	−7	−5	−7	33	−2	−3	−4	−6	59	4	3	5	6
17	42	4	6	10	8	15	−1	−1	0	−2	15	−2	−5	−7	−10	58	5	6	8	5
18	49	2	2	2	−1	14	1	5	7	6	8	−1	−3	−1	0	58	4	4	7	5
19	34	6	12	11	11	22	0	3	4	3	10	2	0	3	5	60	4	3	6	6
20	35	4	9	15	15	7	−3	−3	−6	−7	22	3	2	4	5	60	3	3	6	4
21	36	6	11	17	18	10	−2	0	3	4	33	6	10	12	9	55	4	3	5	5
22	41	5	10	15	16	21	7	10	8	9	51	−1	−3	−3	−8	50	3	3	4	2
23	44	5	9	16	12	17	6	9	11	11	29	3	3	6	6	48	2	2	5	4
24	49	4	7	13	13	16	5	10	14	15	24	5	6	9	8	51	3	3	5	4
25	49	6	10	13	10	19	5	10	18	21	35	4	4	6	7	53	3	4	6	5
26	46	4	9	12	13	26	5	8	14	18	49	1	−1	0	−2	56	2	2	5	4
27	54	1	5	7	8	30	5	9	14	16	51	1	−1	−1	−3	57	1	2	3	3
28	50	2	6	9	13	35	4	10	9	5	49	4	3	3	0	59	1	2	7	6
29	50	5	10	16	18	48	−3	−6	−6	−6	51	2	1	2	−1	60	1	4	6	3
30	56	2	5	8	9	54	−2	−4	−4	−6	53	0	−3	−3	−6	60	2	3	8	5
31	55	2	6	10	11	......	......	......	......	......	56	−1	−4	−6	−9	61	1	3	7	8
Means	45.5	3.0	6.0	8.3	8.2	28.6	3.0	6.1	8.7	8.8	36.4	1.4	0.3	0.9	−0.6	56.8	3.0	2.8	4.7	3.6

INVERSIONS.

Frequency.—In the above table the impressive facts are the almost complete reversal of the usual rule of a decrease in temperature with increase of altitude during both May and November, 1914; a diminution in the amplitude of the variations in winter as exhibited by the record for January, 1916; and the tendency in that month for the natural rule to obtain at the highest station at which the mean minimum was 0.6° lower than at the base station, and finally, the rather regular occurrence of small and, perhaps, unimportant variations in summer as shown by the record of July, 1915.

When the observations of the four-year period are combined into a general mean, the results as shown in the graph Figure 3 appear. This figure gives the average monthly frequency, intensity, and the extreme range of inversions. It may be remarked in connection therewith, that on all the slopes May and November are the months of the greatest frequency and August of the least. The intensity of inversions, however, appears to be greatest in November with a second maximum in April. The extremes are found on the Tryon slope where winter inversions are of greater magnitude than those of spring. It is further remarked that the largest number of inversions noted on all of the six long slopes in any one year was 860, in 1913, and that the largest number on a single slope for the four-year period was 743 on Ellijay. Inversions occur on the short slopes with about as great frequency as on the long slopes.

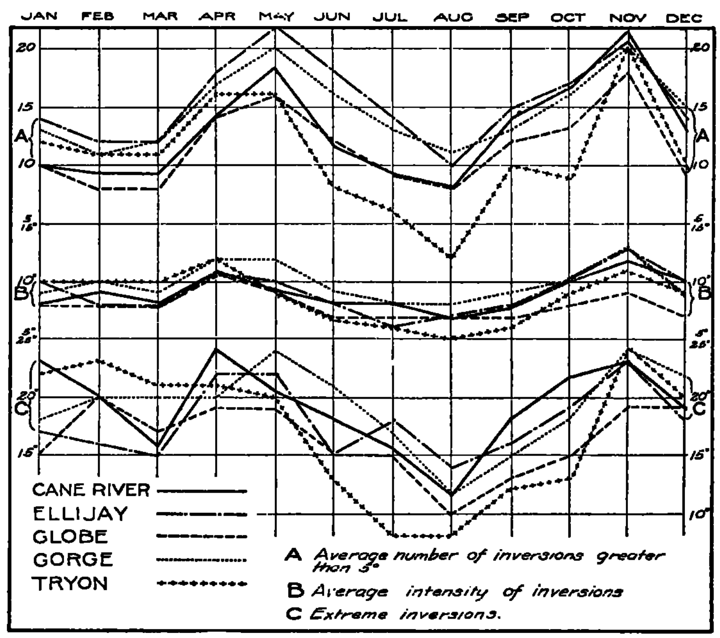


FIG. 3.—Monthly frequency, average, and extreme degrees of inversion on five selected long slopes.

TABLE 3.—*Length of growing season.*

Principal and slope station; elevation of base stations above mean sea level.	Height of slope stations above base (feet).	a	b	c	d	e	f	g	h	i
Altapass:										
No. 1 (base) elevation 2,230		Apr. 10	Oct. 2	Apr. 8	Oct. 15	Apr. 4	Oct. 28	201	175	190
No. 2, SE	250	Apr. 21	Oct. 9	Apr. 12	Oct. 26	...do...	Nov. 15	219	188	197
No. 3, SE	500	...do...	Oct. 10	...do...	Oct. 20	...do...	Oct. 27	195	189	191
No. 4, SE	750	...do...	Oct. 9	Apr. 16	Oct. 25	...do...	Nov. 15	219	175	192
No. 5, summit	1,000	Apr. 27	...do...	...do...	Oct. 19	...do...	Oct. 27	194	174	186
Asheville:										
No. 1 (base) elevation 2,445		Apr. 21	Oct. 2	Apr. 14	Oct. 15	Apr. 10	...do...	200	175	184
No. 2, N	155	Apr. 28	Oct. 9	Apr. 16	Oct. 20	Apr. 4	...do...	195	176	187
No. 2a, S	155	...do...	...do...	...do...	...do...	...do...	...do...	195	176	187
No. 3, N	380	...do...	...do...	...do...	...do...	...do...	...do...	193	176	187
No. 3a, S	380	...do...	...do...	...do...	...do...	...do...	...do...	195	176	187
Blantyre:										
No. 1 (base) elevation 2,090		May 20	Sept. 22	Apr. 30	Oct. 8	Apr. 19	Oct. 28	173	153	161
No. 2, NW	300	Apr. 21	...do...	Apr. 16	Oct. 7	Apr. 10	Oct. 27	189	154	174
No. 3, NW	450	...do...	Oct. 9	Apr. 12	Oct. 17	Apr. 4	...do...	190	185	188
No. 4, NW	600	...do...	...do...	...do...	Oct. 20	...do...	...do...	194	188	191
Blowing Rock:										
No. 1 (base) elevation 3,130		May 11	Oct. 1	Apr. 22	Oct. 14	Apr. 10	...do...	189	162	175
No. 2, S	450	...do...	Oct. 9	...do...	Oct. 17	...do...	...do...	189	162	178
No. 3, SE. (base)	450	May 20	Sept. 20	May 5	Sept. 23	Apr. 18	Sept. 27	158	130	141
No. 4, SE	625	May 11	Sept. 22	Apr. 26	Oct. 7	Apr. 15	Oct. 27	189	134	164
No. 5, SE	800	...do...	...do...	...do...	...do...	...do...	...do...	189	134	164
Bryson:										
No. 1 (base) elevation 1,800		May 12	Sept. 22	Apr. 28	Oct. 8	Apr. 19	Oct. 28	190	133	163
No. 2, N	385	Apr. 21	Oct. 2	Apr. 11	Oct. 13	Mar. 29	...do...	199	175	185
No. 2a, S	385	Apr. 28	...do...	Apr. 16	...do...	...do...	...do...	199	157	180
No. 3, summit	570	Apr. 21	Oct. 9	Apr. 8	Oct. 20	Mar. 28	...do...	206	188	195
Cane River:										
No. 1 (base) elevation 2,650		May 20	Sept. 23	May 5	Oct. 6	Apr. 19	Oct. 27	173	134	154
No. 2, N	190	May 11	Oct. 2	Apr. 22	Oct. 14	Apr. 11	...do...	189	162	175
No. 3, NE	400	Apr. 29	...do...	Apr. 19	...do...	...do...	...do...	189	174	178
No. 4, summit	1,100	...do...	Sept. 30	Apr. 22	...do...	Apr. 13	...do...	189	156	175
Ellijay:										
No. 1 (base) elevation 2,240		Apr. 28	Sept. 22	Apr. 24	Oct. 8	Apr. 18	Oct. 28	190	148	166
No. 2, N	310	Apr. 21	...do...	Apr. 10	...do...	Apr. 6	...do...	190	169	181
No. 3, N	620	...do...	Oct. 9	Apr. 12	Oct. 19	Apr. 4	Oct. 27	193	188	190
No. 4, N	1,240	Apr. 28	...do...	Apr. 16	...do...	...do...	...do...	194	175	186
No. 5, summit	1,760	Apr. 27	...do...	Apr. 17	...do...	...do...	...do...	189	177	185
Globe:										
No. 1 (base) elevation 1,625		Apr. 22	Oct. 10	Apr. 17	Oct. 20	Apr. 10	Oct. 28	195	178	186
No. 2, E	300	Apr. 11	...do...	Apr. 6	Oct. 26	Mar. 28	Nov. 15	219	189	203
No. 3, summit	1,000	Apr. 21	...do...	Apr. 8	Oct. 20	...do...	Oct. 27	207	188	195
Gorge:										
No 1 (base), elevation 1,400		May 12	Oct. 2	Apr. 27	Oct. 16	Apr. 16	Oct. 28	190	157	172
No. 2, N. E	290	May 11	...do...	Apr. 22	Oct. 15	Apr. 10	...do...	190	163	176
No. 3, S	615	...do...	...do...	Apr. 19	...do...	Apr. 4	...do...	190	163	179
No. 4, N. (old)	840	Apr. 21	Oct. 10	Apr. 8	Oct. 26	Mar. 29	Nov 15	219	189	201
No. 4, NE. (new)	840	...do...	...do...	...do...	...do...	Mar. 28	Nov. 16	220	189	201
No. 5, summit	1,040	...do...	...do...	...do...	...do...	...do...	...do...	220	189	201
Hendersonville:										
No. 1 (base), elevation 2,200		Apr. 30	Sept. 22	Apr. 23	Oct. 8	Apr. 19	Oct. 28	190	153	168
No. 2, E	450	Apr. 28	...do...	Apr. 22	...do...	Apr. 14	Oct. 27	189	147	169
No. 3, E	600	...do...	...do...	Apr. 16	Oct. 12	Apr. 4	...do...	194	147	179
No. 4, summit	750	...do...	Oct. 9	...do...	Oct. 20	...do...	...do...	194	176	187
Highlands:										
No. 1 (base), elevation 3,350		...do...	Oct. 10	...do...	...do...	...do...	...do...	194	175	187
No. 2, SE	200	...do...	Sept. 22	...do...	Oct. 12	...do...	...do...	193	147	179
No. 3, SE	325	June 14	Sept. 21	May 29	Sept. 23	May 10	Sept. 26	135	100	117
No. 4, SE	525	Apr. 29	Sept. 22	Apr. 20	Oct. 3	Apr. 5	Oct. 27	189	146	166
No. 5, SE	725	...do...	...do...	Apr. 22	Oct. 7	Apr. 13	...do...	189	146	168
Mount Airy:										
No. 1 (base), elevation 1,340		Apr. 21	Oct. 10	Apr. 11	Oct. 18	Apr. 4	Oct. 28	201	184	190
No. 2, W	160	Apr. 10	...do...	Apr. 4	Oct. 26	Mar. 28	Nov. 15	219	189	205
No. 3, E	160	Apr. 21	...do...	Apr. 11	...do...	Apr. 4	...do...	219	184	198
No. 4, summit	360	Apr. 10	...do...	Apr. 8	...do...	Apr. 5	...do...	219	189	201
Transon:										
No. 1 (base), elevation 2,970		June 11	Sept. 20	May 17	Sept. 23	Apr 18	Sept. 27	158	103	129
No. 2, W	150	May 11	Oct. 2	Apr. 22	Oct. 14	Apr. 11	Oct. 27	189	162	175
No. 3, W	300	...do...	Oct. 1	...do...	...do...	Apr. 10	...do...	189	162	175
No. 4, summit	450	...do...	Oct. 9	Apr. 19	Oct. 17	Apr. 4	...do...	189	162	181
Tryon:										
No. 1 (base), elevation 950		Apr. 27	Oct. 21	Apr. 16	Nov. 2	Apr. 5	Nov. 16	213	182	200
No. 2, SE	380	Apr. 10	...do...	Mar. 30	Nov. 8	Mar. 23	...do...	232	207	223
No. 3, SE	570	...do...	...do...	...do...	Nov. 5	...do...	Nov. 15	226	207	220
No. 4, SE	1,110	...do...	Oct. 9	Apr. 6	Oct. 20	Mar. 28	Oct. 28	207	188	197
Wilkesboro:										
No. 1 (base), elevation 1,240		Apr. 22	Oct. 11	Apr. 15	Oct. 18	Apr. 11	...do...	200	177	186
No. 2, N	150	Apr. 11	Oct. 10	Apr. 6	Oct. 24	Mar. 29	Nov. 8	212	189	203
No. 3, N	350	Apr. 10	...do...	...do...	Oct. 26	...do...	Nov. 15	219	189	203
No. 4, W	430	...do...	Oct. 20	...do...	Nov. 5	...do...	Nov. 16	226	201	211

(a) Date of last freezing temperature in spring during four-year period.
(b) Date of first freezing temperature in autumn during four-year period.
(c) Four-year average date of (a).
(d) Four-year average date of (b).
(e) Earliest date of last freezing temperature in spring during four-year period.
(f) Latest date of first freezing in autumn during four-year period.
(g) Length in days of longest growing season, or interval between (a) and (b) of same year.
(h) Length in days of shortest growing season, or interval between (a) and (b) of same year.
(i) Average length of growing season, or interval between (c) and (d).

TOP FREEZES AND NORMS.

Under the above caption Professor Cox discusses those cases where cold north and northwest winds in the rear of cyclones sweep over the terrain, bringing low temperature alike to mountain top, slope and valley below. These winds are characteristically cold and blow with sufficient force to displace any warm air that may still linger on the valley floor. The pressure gradient upon which these winds depend is greatest, of course, in winter

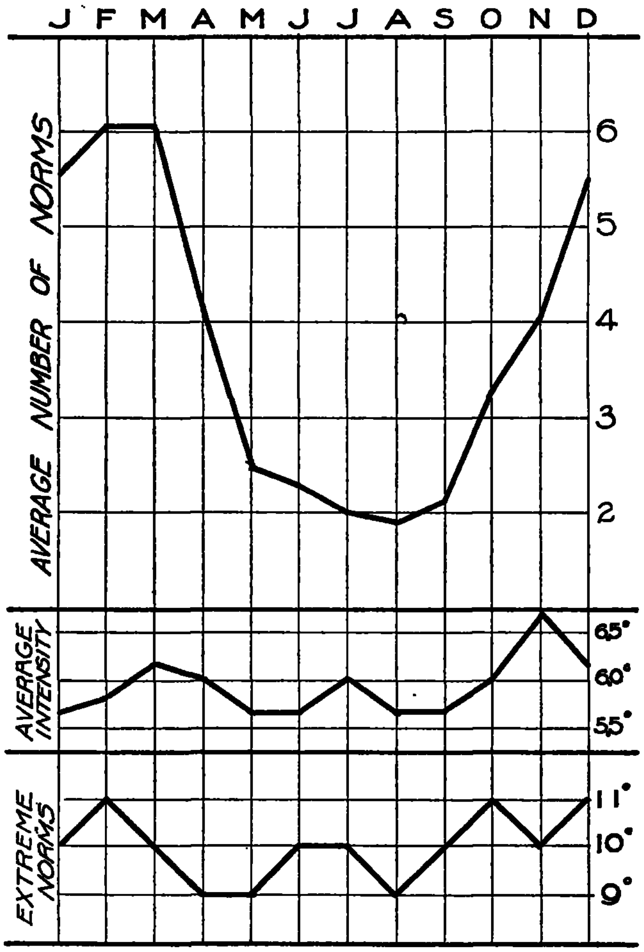


FIG. 4.—Monthly frequency and average and extreme degrees of norm on six long slopes.

and naturally the incursions of cold air are most frequent in that season. The average distribution throughout the year is shown in Figure 4.

HOUR-DEGREES OF FROST (HF°)

Hour-degrees of frost is the term used to express the duration of temperatures below 32°. The numbers are obtained by measuring with a planimeter the area on the thermograph trace sheets between the 32° line of the sheet and the course of the curve when it passed below that line. The author presents two graphs—Figures 5 and 6—which illustrate graphically the number of HF° at the stations on the various slopes. Figure 5 shows that the largest number of HF°, for 10 selected inversions, was 173 at station No. 3 in the Waldheim orchard—a station in a frost pocket in that orchard.

AUTHOR'S CONCLUSION.

"It should be apparent from the data presented in the discussion that minimum temperature and its duration are the chief factors involved in the growing of fruit in the North Carolina mountain region, just as they are in any other orchard region, provided, of course, sufficient moisture is supplied through rainfall or irrigation.

"However, maximum temperature is often a consideration. It has been shown that the maxima are much higher in the winter on a southerly than on a northerly slope and in all seasons of the year higher on a westerly than on an easterly slope. But relatively high maximum temperatures are not always to be desired. Where the maximum is abnormally high in the winter and spring, so as to force the buds prematurely, there is danger of damage from ensuing frosts or freezes, sometimes in contrast with slopes where the maximum does not rise so high. In any case, shade must be avoided such as noted in the upper portions of the orchards at both Asheville and Cane River, because it not only prevents necessary sunlight, but also serves to reduce the sensible temperature after precipitation to a lower point

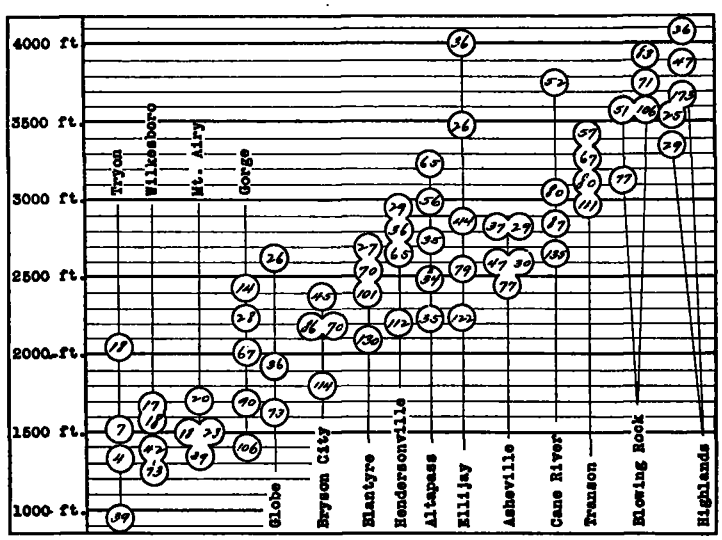


FIG. 5.—Average number of hour-degrees of frost, 10 selected inversions.

than that shown by the thermometer through the retention of the moisture on the vegetation and fruit.

"So far as the minima are concerned, it is obvious that great care should be taken in the selection of a site for an orchard. Valley floors must in nearly all cases be avoided. There the temperature on critical nights of inversion often falls 15° or 20°, and sometimes even 25° or 30°, lower than higher up on the slope.

"Some valley floors are, moreover, colder than others. Wide floors, such as those at Blantyre and Bryson, surrounded by high mountains at some little distance, where the loss of heat through radiation is quite rapid, are somewhat colder than other floors closely shut in, such as at Ellijay. The latter is not, indeed, warm, but its slightly higher minima as compared with Blantyre and Bryson are due to obstructed radiation, although the area of radiating surface in the immediate vicinity of the closed-in floor is unusually large, but not sufficient to offset the obstruction referred to by raising the sky line.

"Valley floors similar to those at Tryon and in the Flat Top orchard at Blowing Rock have been shown to be warm on certain nights of inversion considering their elevation above sea level, both relatively warmer than Ellijay, and this, too, in spite of the fact that the floor at Tryon, especially, is wide. However, the higher average minima at Tryon, as well as Blowing Rock, are due to the prevalence of the nocturnal mountain breeze down the slope and valley from the great surface area around the summer station. During nights of inversion, when conditions are not favorable for the mountain breeze, the temperature falls at these two places comparatively low.

"While the great area above is responsible for the nocturnal breeze and the raising of the minima on the floor, it, at the same time, causes low temperature at the higher levels, because of the large area of radiating surface in proportion to the air available for interchange, so that on such slopes as these two, as well as at Altapass, the upper levels are cold and the valley floors often comparatively warm.

"This research has shown that the mountain breeze does not develop at night and flow down a valley unless there is great surface area around the summit station. On no valley floor where the slopes culminate in knobs has the nocturnal breeze been noted. The thermograph traces on the floors at Bryson, Blantyre, Ellijay, Gorge, Cane River, and Mount Airy, all with small mass, never show any sign of the mountain breeze. Before such a breeze develops a relatively large amount of heavier and potentially colder air above must form, and this can only

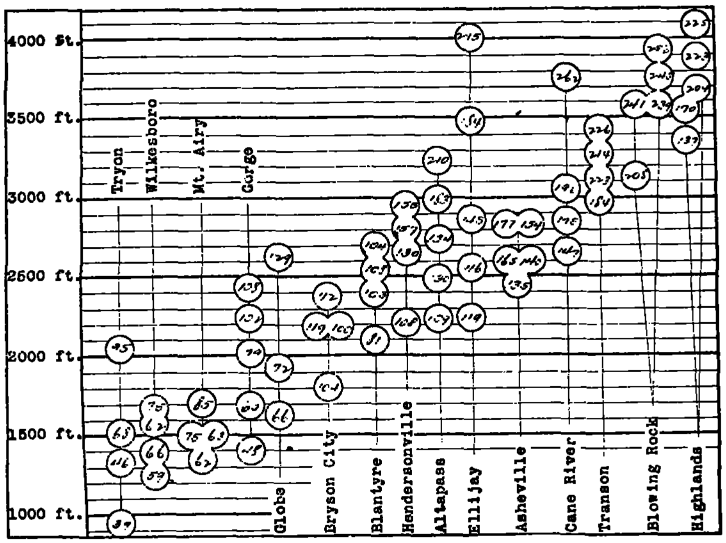


FIG. 6.—Average number hour-degrees of frost, 10 selected norms.

develop over a plateau-like surface. There is no opportunity for such development over a knob. Where the highest points are mere peaks or knobs, they partake of the temperature of the free air surrounding and are always relatively warm on nights of inversion, and this, too, in spite of the fact that a knob is best situated topographically for loss of heat through radiation, as its angle of free radiation may exceed even 180°.

"The descending nocturnal breeze may properly be compared with a waterlike flow as it passes down the slope and mixes with the cold air of the valley floor, and it is entirely unlike the slow exchange of free air over a valley with that resting on a slope. The cold air sometimes collects on benches or coves on a slope, and when great difference in density exists between it and the neighboring free air the cold air slips off and passes down the slope, immediately giving place in turn to warmer air. Such a phenomenon has often been observed at Blantyre on the descending slope near the base of little Fodderstack.

"Coves and even shelves or benches on slopes should be avoided so far as practicable in the planting of fruit trees because of the low night minima, making possible the formation of frost there, while other portions of the slope entirely escape.

"Many topographical conditions are involved in their effect upon the minima on a slope. Generally speaking, the steeper the slope the warmer it is during nights of inversion. At the same time, if there is a steep slope directly opposite and close by, making the valley deep and narrow, the entire slope will be relatively cold, rather than warm, up to the level where the free air becomes practically limitless, although, as already stated, its base may be warmer than a wide valley floor. If this steep slope has no opposing slope and it culminates in a knob above, it will be relatively warm its entire length. A gradual slope is naturally colder than a steep one, and the nearer it approaches to the level of a plain the colder it is.

"On a short slope culminating in a knob no more than 500 feet in elevation the height being insufficient to cause more than a degree or two difference in temperature between valley floor and summit on nights of norm conditions, such as Blantyre, Bryson, and Mount Airy, the summit is the safest section for fruit growing, because during nights of inversion the highest minima are practically always registered at that level. This usually is the case on slopes even up to levels as high as 1,000 feet above the valley floor, as Gorge and Cane River. It has been shown that the center of the thermal belt on some nights of inversion is even as high as the summit of Ellijay, 1,760 feet above the valley floor, and on the average the thermal belt is centered more than 1,200 feet above that floor, due to the fact that the portion of the slope lower down is comparatively cold. However, there is always greater danger from top freeze at the higher elevations of long slopes, and these at Ellijay, for instance, have a greater number of H F° on the average than the level of 600 or 700 feet above the floor. Usually on a slope having an elevation of 1,000 feet or more above its floor the safest level, from the standpoint of the number of H F° from inversion and norm conditions combined, is from 300 to 700 feet, but on slopes having a very small grade and terminating in a knob, as Gorge, the safest point is at the very summit.

"Moreover, if the summit at Ellijay were immediately surrounded by great surface area at that level, as at Tryon and Altapass, instead of being on a mere knob, it would be much colder, and this would serve to reduce the temperature generally over its upper levels, so that the level of the thermal belt would be correspondingly lowered and its width reduced to very small limits. Such a slope would indeed be a cold one practically from base to summit, if there were high opposing slopes close by.

"While the slopes at Bryson and Blantyre are warm as compared with their respective floors during nights of inversion, they are, nevertheless, relatively cold for their elevation, because they are located in vast frost pockets formed by surrounding mountains which tower above at considerable elevation. Frost pockets must be avoided as far as practicable, whether large or small. The one in the Waldheim orchard at Highlands, a small depression or sink, although much unlike those at Bryson and Blantyre, is nevertheless equally objectionable.

"An ideal slope for fruit growing is one of moderate elevation above sea level, the basic altitude varying, of course, in different portions of the country, fairly steep and culminating in a knob with no surrounding mountains, or if any, at least, situated so far distant as to have no effect upon the temperature conditions of the slopes involved, such as Mount Airy and Wilkesboro, or the lower levels of a slope such as Tryon, which is warm because of the absence of opposing slope and because of the influence of the nocturnal breeze, although its upper levels are cold on account of the great area surrounding the summit.

"The subject of vegetation must be considered, dense vegetation being responsible for great loss of heat through radiation, and a cultivated orchard is therefore warmer than one planted in grass.

"The data presented in this study make plain the necessity for great care in the selection of a property for the purpose of fruit growing. The topography of a region is paramount. Frost pockets should be avoided and valley floors of all kinds as far as practicable, unless means are available for orchard heating. The altitude above sea level is in every case a consideration and, in a degree, the elevation above the valley floor.

"All these questions must be given careful consideration and the effect of one upon another weighed in the balance. No hard and fast rule can be made in the determination, as the factors involved are so many and so complicated that each site must be considered by itself."

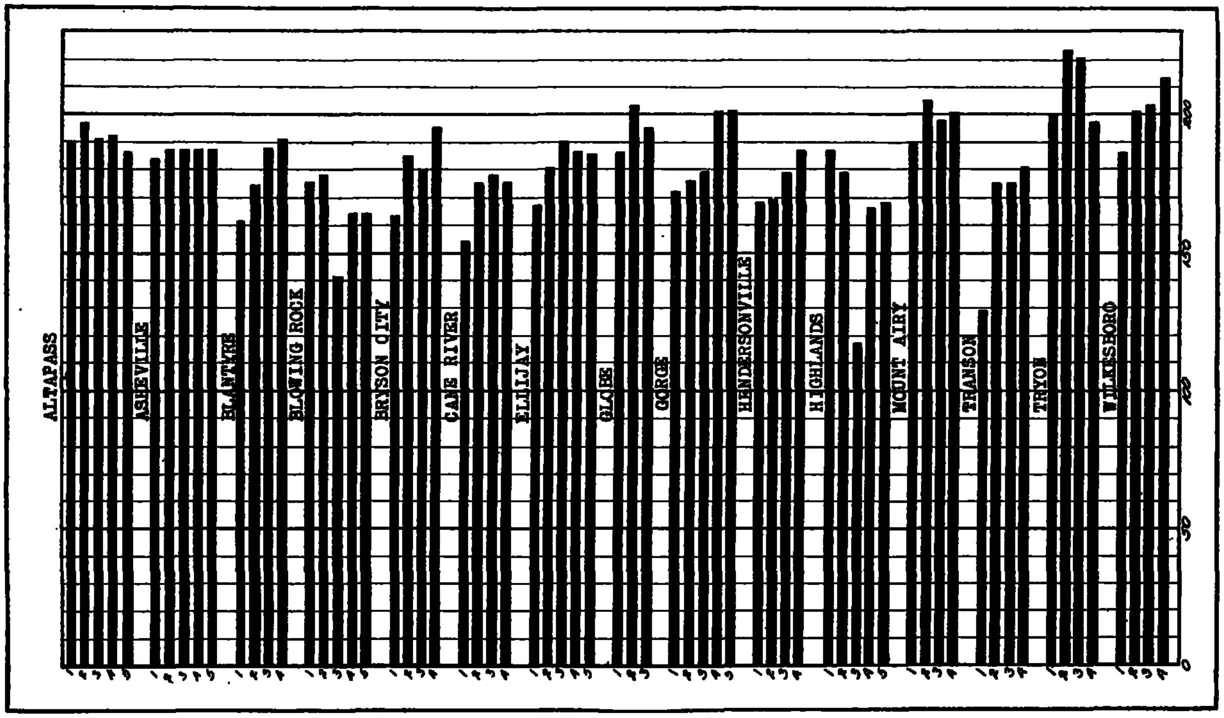


FIG. 7.—Length of growing season.

THE RAINFALL OF JAMAICA.[1]

Under the above title is presented the third report on the rainfall of Jamaica by the same author, bringing the statistics down to the end of 1919. Unfortunately, the author did not live to see the completion of his work, but his daughter, Miss C. Maxwell Hall, with the aid of Mr. J. F. Brennan, Government meteorologist, has faithfully carried the work to a conclusion. The first part of the work is devoted to presenting the monthly and annual averages for a total of about 250 stations well scattered over the island. The latter is divided into five unequal portions, viz, Northeast, Central, West Central, North, and South. The three subdivisions first named form a somewhat irregularly shaped zone extending almost entirely across the island from east to west, and it contains the most elevated parts. The average elevation of the stations in the Northeast is 1,375 feet, and that subdivision has naturally the greatest rainfall; the next subdivision in point of elevation is the West Central, with 960 feet, and finally the coastal regions of both the north and the south of the island have an elevation of 472 and 490 feet, respectively.

The 50-year monthly means for the island as a whole are presented in Table 1 below.

In Table 2 will be found the annual amounts for each of the five principal subdivisions and for each year of the period 1870–1919. These data will serve as valuable material in the study of the secular variation of rainfall in the Tropics.

[1] The rainfall of Jamaica from about 1870 to 1919, by Maxwell Hall, M. A., F. Roy. Met. Soc., Government meteorologist.

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